

Genetic Affinities of Prehistoric Easter Islanders: Reply to Langdon

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Last year my colleagues and I published a short article in the journal *Nature* (Hagelberg *et al.* 1994) describing the analysis of genetic polymorphisms in bones of prehistoric Easter Islanders. A few months later I was interested to read a manuscript disputing our DNA result, submitted by Robert Langdon to *Nature*. Langdon's letter was not accepted for publication, a pity in my opinion, as it might have stimulated a lively correspondence on Easter Island origins. However, Langdon has now included his rather vehement response to our DNA data in the longer article published here, in which he presents his own ideas on the origins of the prehistoric Easter Islanders.

The main argument of his critique is that sometime between the first human occupation of Easter Island and the arrival of Jacob Roggeveen in 1722, the island was settled by a group of people of part-European, possibly Basque descent. Although this is an interesting theory that undoubtedly merits some consideration, it is irrelevant to the fundamental question of Easter Island origins and does not conflict with our genetic evidence of a Polynesian origin of prehistoric Easter Islanders. We were constrained in our original article by the space limits imposed by *Nature* and were unable to elaborate on the significance of our results. Therefore, I would like to explain our conclusions, and discuss Langdon's hypothesis briefly in the context of the DNA results and of some of the latest findings on Easter Island origins.

Advances in molecular biology techniques in the last fifteen years have started to make a significant contribution to the study of human genetic variability. Variability in modern people helps us understand the evolutionary history of the human species, particularly when the genetic data are compared with linguistic, anthropological and archaeological evidence. Informative genetic loci are continuously being identified, but many researchers, ourselves included, have chosen to work with a type of DNA called mitochondrial DNA (mtDNA) contained in the mitochondria, cellular organelles involved in respiration. In humans, mtDNA is about 16,500 base pairs in length, compared with the 3,000,000,000 base pairs of the DNA in the cell nucleus; so it carries only a minuscule proportion of the genetic information of the cell. Nevertheless, mtDNA is extremely useful for phylogenetic and evolutionary studies because it is simple, easy to analyse, evolves rather quicker than nuclear DNA, and is passed on from generation to generation through the maternal line. MtDNA does not undergo recombination (the shuffling of maternal and paternal genes that occurs in nuclear DNA from generation to generation), and this simplifies the investigation of lines of descent; a child's mtDNA is identical to its mother and maternal grandmother and so on, except for the relatively rare changes introduced over time by genetic mutation. MtDNA can be

used to follow female lineages in the same way that surnames can be used to trace male lineages.

MtDNA is fairly variable in human populations. For instance, in a survey of 100 Caucasian males in Britain, Piercy *et al.* (1993) observed 90 different mtDNA types. Several research groups have started to look at the extent of mtDNA variability in modern Pacific populations to help test models for the colonization of Polynesia. In 1989, Hertzberg and colleagues at the Australian National University discovered that a harmless mutation, previously known to occur in some people of Asian origin (including native Americans), was present throughout the Pacific, reaching a frequency of 100% in some Polynesian archipelagos. The mutation, known as the 9 base pair deletion, was observed in coastal Papua New Guinea (14%), but not in Papua New Guinea highlanders or Australian aborigines. Hertzberg and colleagues concluded that the pattern of distribution of the deletion in the Pacific supported the "fast train" hypothesis of a recent settlement of Polynesia from island Southeast Asia, with little genetic admixture between the proto-Polynesian colonizers and the people who had previously settled Melanesia (Hertzberg *et al.* 1989).

Since Hertzberg's study, additional Asian and Pacific populations were surveyed for the 9 base pair deletion. In addition, the search began for additional mtDNA markers specific to Polynesians. We and others (Hagelberg & Clegg 1993; Lum *et al.* 1994) observed a number of positions in the mtDNA of modern Polynesians that differ from that of people in other geographical locations. A Polynesian-specific mtDNA type was identified, characterized by the 9 base pair deletion and DNA substitutions at mtDNA position numbers 16217, 16247 and 16261. We detected this mtDNA type in modern people throughout Polynesia and the Polynesian outliers (unpublished observations), and also in prehistoric bones from several sites in Polynesia, including New Zealand and Hawaii (Hagelberg & Clegg 1993).

This mtDNA type is extremely uniform throughout the vast triangle of eastern Polynesia, with approximately 95% of modern people sharing the type and a few minor variant forms (this contrasts dramatically with the high degree of variability in the British sample mentioned above). The reduced genetic variability in Polynesians is probably the result of a stringent population bottleneck sometime during the colonization of the eastern Pacific. Concerning Easter Island origins, we analysed DNA from 12 prehistoric human bones excavated by Thor Heyerdahl during the Norwegian Archaeological Expedition of 1955-56, and kept in the Museo de Historia Natural, Santiago de Chile. The bones were from two sites, Ahu Tepeu (AD 1100-1680) and Ahu Vinapu (AD 1680-1868), on the west and south coast of the island respectively. All of the samples yielded DNA with the

9 base pair deletion and the characteristic Polynesian base substitutions at 16217, 16247 and 16261. We also observed two additional minor variants of the Polynesian type (see Table 1).

We suggested that this result links Easter Island genetically with Polynesia, rather than South America. Although the 9 base pair deletion exists almost everywhere in the Americas (with the exception of the Circumarctic region), it is associated with many different mtDNA base substitutions as there is considerably more mtDNA diversity in the Americas than in Polynesia. Assuming, as others have before us, that Easter Island was settled only once during prehistory, the presence of the Polynesian-specific genetic markers in Easter Islanders points to a settlement from the west, as colonization from the Americas would have revealed mtDNA types other than the Polynesian type.

We are left with the possibility of multiple migrations to Easter Island and/or South American contacts, either direct or via eastern Polynesia, not picked up by our limited sampling of skeletal remains. I will deal with these in turn. Voyage simulation studies, linguistic evidence, and the relative dearth of Polynesian material goods and domesticates in Easter Island argue against multiple contacts with Polynesia (Irwin 1992). However, Heyerdahl (1989) proposed that Easter Island was settled twice, first by South American people associated with a pre-Tiwanaku culture (the long ears), and later by the "culturally inferior" Polynesians (the short ears) who eventually wiped out the Americans. The Polynesian cranial features observed in the relatively late Ahu Vinapu and Ahu Tepeu skeletons (Murrill 1965) were therefore easily explained by Heyerdahl's hypothesis that the Polynesians were late arrivals in the island. In Heyerdahl's model, the early South Americans cremated their dead so their skeletal remains are not available for analysis (see Heyerdahl's addendum to Murrill 1965).

Heyerdahl's arguments for a settlement from South America are well known, particularly his comparisons between birdman motifs in Easter Island and Peru, but in my opinion are based rather heavily on circumstantial evidence. Whereas our observation of Polynesian genetic markers in recent prehistoric skeletons does not refute Heyerdahl's two settlement hypothesis, there seems to be a lack of clear-cut scientific evidence for the latter.

Langdon is a bullish supporter of Thor Heyerdahl's views on a South American influence in Easter Island, but I find the relevance of his theory to the colonization debate rather puzzling. Langdon suggests that at the time of European contact many Polynesians, including Easter Islanders, were the descendants of the crew of the Spanish caravel *San Lesmes* which disappeared in the Pacific in 1526. He argues that the ship was wrecked in the Amanu Atoll and that the crew eventually reached Ra'iatea, 200 km northwest of Tahiti, where some of the men married Polynesian women. Eventually, some of their descendants reached Easter Island.

Langdon bases his theory partly on the anecdotal evidence for the presence of tall, fair people in Easter Island at the time of European contact, but also on an interesting study carried

out in the early 1970s by a team led by Nobel Prize winner Jean Dausset (Thorsby *et al.* 1972). Dausset and his colleagues collected blood samples from Easter Islanders with no known foreign admixture and investigated a number of genetic systems, including the highly polymorphic HLA types. The results indicated very low levels of genetic variability in this group, hardly surprising in view of the close degree of relationship between the typed individuals. Interestingly, of the 49 "pure" individuals investigated, 18 (that is, over 36%) exhibited a particular HLA type, A29/B44 (12), that is present at relatively high frequencies in Europeans, including Basques.

Bahn and Flenley (1992) suggested that this strange finding could be the result of the genetic contribution of a Basque sailor to the Easter Island gene pool sometime during the nineteenth century. Langdon thinks this explanation is untenable for a number of reasons, but mainly because it would take several generations for the high frequency of the A29/B44 (12) to be reached in the native population. It seems as if all the people tested by Dausset could be traced back to one single male, Pakomio Mori, born about 1816. Pakomio was one of the 1400 Easter Islanders who were kidnapped in the Peruvian slave raids of 1862, and one of the 15 who survived smallpox and other diseases and were repatriated. Langdon believes that the Basque genes had to be already widely distributed in the native population before the Peruvian raids and that Pakomio could not have been the only carrier of those genes (or just one of a handful of people of European ancestry), otherwise "the chance of the Basque genes surviving transportation to Peru and back would have been only one in 1400".

However, this is not necessarily the case. Langdon has disregarded the possibility that the Basque genes carried by Pakomio could have conferred on him resistance to European infectious diseases. Thus, even if Pakomio was the only person of part-European descent at the time of the raids, the likelihood of his survival would have been greatly enhanced. Although still an area of considerable research and debate, the role of HLA genes in resistance to infectious diseases is being increasingly recognized by medical scientists.

It is important to note that the typing of the HLA genes was fairly rudimentary in 1972 and since then several informative subtypes have been identified. The haplotype HLA A29/B44 (12) observed by Dausset's team is found in Basque, Cornish, English, Portuguese, Spanish, French, German, Belgian, Italian, and Danish people, as well as in persons of European ancestry throughout the New World and Australia. It is also present in South African blacks, African Americans and Australian Aborigines (Tsuji *et al.* 1991). The new subtypes that have been identified are complex and difficult to distinguish even today. Nevertheless, the Easter Island type may well have been introduced by a Basque or Spanish sailor in the nineteenth century. If the native population had been severely reduced by disease the European genes might have expanded rapidly in the surviving population, to give the result observed in 1972. In short, while there were many opportunities for European

genes to spread in the Easter Island population after European contact, there is little evidence that there was genetic admixture before Roggeveen's time. But even if the *San Lesmes* theory is correct, it fails to shed light on the question of the original settlement of the island, or contradict our mtDNA results.

Langdon states further that Pakomio had "red hair, blue eyes, a light skin and strikingly European features", although no source is provided for this piece of anecdotal evidence. This observation is presented as conclusive proof that Pakomio could not have been the son of a European sailor of post-Roggeveen times, as red hair and blue eyes are coded by recessive genes and could only be expressed in Pakomio if both parents were carriers of the traits. However, I have a number of reservations about this statement: First, the reliability of the evidence is uncertain; second, the colouring of an individual is a subjective characteristic liable to be exaggerated by witnesses; and third, there may well have been a significant number of men and women of part European descent on Easter Island by the early nineteenth century as a result of encounters with sailors of visiting ships in post-Roggeveen times.

The conclusion of Langdon's thesis is that approximately 30 Hispano-Polynesian men and women, including one with Basque genes, arrived in Easter Island close to 1680, fitting in with Heyerdahl's view that the Polynesians arrived around that time. They found an island occupied by people of South American origin who had been the only inhabitants since their arrival about 600 years before. The arrival of the Hispano-Polynesians triggered wars, disease and demographic collapse.

However, we now come to some important findings that contribute to this interesting debate: in the course of recent archaeological excavations at Anakena, Skjølsvold and colleagues of the Kon-Tiki Museum in Oslo (Skjølsvold 1994) recovered bones of the Polynesian rat (*Rattus concolor*) throughout the cultural layer and all the way down to bedrock. In addition, among the artefacts there were two coral files of the same type as found in the Marquesas. Skjølsvold admits that the radiocarbon dates on Easter Island are problematic, but that the date of the settlement of Anakena, probably at the end of the period of AD 800-1000, may possibly be valid for Easter Island as a whole. In that case, if we speculate two distinct settlement events to fit with Heyerdahl's model, we would have the Polynesians as the first settlers around AD 1000, followed by the *ahu* builders from South America about AD 1200. According to Skjølsvold, this would be in good agreement with the chronology of the pre-Inca Cuzco and Tihuanako masonry. Skjølsvold also quotes recent research on non-metric cranial traits by Chapman (1993) to support the idea that two distinct human groups occupied the island. Chapman detected a rough east/west divide on Easter Island, and has identified a small amount of apparently Amerind genetic influence in skulls from the west of the island.

The cranial analyses by Patrick Chapman and George Gill (Chapman 1993; Gill & Owsley 1993) lead to a number of

additional permutations to explain possible South American influences in Easter Island, including that a boat load of Americans arrived during the middle period and took wives among the Polynesians, or that the first inhabitants of Easter Island were Polynesians on their return from South America, joined by several Amerindian *ahu* builders (Gill 1994). In my opinion, any of these theories may be true, but they are mere speculations unless supported by hard data. Voyage simulation studies indicate that Polynesians may well have overshot the most easterly islands of Polynesia during their eastward expansion, and a return voyage would be plausible using the trade winds. Nevertheless, we need some scientific evidence for any serious suggestion that South American people had a significant impact on Easter Island life and culture.

This brings me back to Langdon's hypothesis. His theory rests on the idea that the Americans were the only settlers of Easter Island until the arrival of the presumed Hispano-Polynesians in the seventeenth century. However, if the Polynesians were the first settlers, as indicated by the latest findings from Anakena, when does he think the Amerinds arrived, and how can he explain the presence of Polynesian genetic markers in the relatively late Easter Island bones that we analysed?

One important thing remains to be done, and that is to search for informative genetic markers in the bones from sites in the east of the island where the Amerind cranial features are found. Even in the unlikely event that every one of the Amerind settlers was male and unable to pass on mtDNA to his offspring, these people must have left behind their own bones with American genetic markers. In order to make a significant impact on the culture and genetics of the Polynesians, there must have been a reasonable number of American people in Easter Island, and if that was the case sooner or later their bones will turn up.

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TABLE 1. Mitochondrial DNA polymorphisms in prehistoric Easter Islanders, compared with the human mtDNA reference sequence. The three base substitutions at positions 16217, 16247 and 16261, and the 9 base pair deletion, are typical of Polynesians.

Sample	mtDNA position					9 base pair deletion
	16217	16247	16261	16271	16292	
Reference sequence ¹	T	A	C	T	C	-
"Polynesian haplotype" ²	C	G	T			+
Prehistoric Easter Islanders						
Ahu Tepeu (1100-1680)						
29967	C	G	T	*	*	+
29970	C	G	T	C	*	+
29972	C	G	T	*	*	+
29992	C	G	T	*	*	+
Ahu Vinapu (1680-1868)						
29932	C	G	T	*	*	+
29940	C	G	T	*	T	+
29941	C	G	T	*	T	+
29942	C	G	T	*	*	+
29943	C	G	T	*	*	+
29944	C	G	T	*	*	+
29947	C	G	T	*	*	+
29950	C	G	T	*	*	+

1 Anderson *et al.* 1981

2 Hagelberg & Clegg 1993

A Final Reply to Langdon

Paul Bahn and John Flenley

There is little that we can usefully add to Erika Hagelberg's response, and we will therefore limit ourselves to a few salient points.

1) Langdon has misread our earlier reply—we never claimed that he had ignored the likelihood of a European ship visiting the island before Roggeveen. All we said was that he had ignored the fact that we ourselves mention such a likelihood on p.13 of our book (see *RNJ* 8(1):11).

2) In our earlier reply we clearly set out the arguments—which we consider very sound—in favor of the view that de Olaondo's unique and bizarre testimony about maize and white potatoes is highly untrustworthy; we prefer Forster as a botanical observer, and it seems to us extremely unlikely that

he would have missed cassava. Langdon persists in placing his faith in the completely untrained de Olaondo, and clearly nothing we can say will alter his wishful thinking on this matter. We can only agree to disagree.

3) We are bemused by Langdon's *modus operandi*, his constant reliance on assumption and, especially, on "odds" and spurious percentages: for example, why assume that half of every crew had sex with young women or that 10% of such sailors were Basques? Why not vice versa, or 100% and 20% respectively? It is intriguing that he does not also calculate the odds of the crops reported by de Olaondo (and presumably grown for many centuries by supposed Amerindians on the island) suddenly "falling out of cultivation" in the four years before Forster arrived!

4) Finally, as Erika Hagelberg has pointed out, Langdon has been left high and dry by the Heyerdahl camp. Heyerdahl, as Langdon emphasizes, has always insisted that Amerindians were the island's only inhabitants until Polynesians arrived towards the end of the Middle Period; he